Management of Posterior Fossa Dissecting Aneurysms

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Summary

Treatment and prognosis of 14 patients of posterior fossa arterial dissections (AD) and dissecting aneurysms (DA) in one institution was reviewed. Internal trapping of aneurysm was performed for six patients presenting with SAH (three Vertebral, one posterior cerebral, one posterior inferior cerebellar, one anterior inferior cerebellar DA). The patency of the parent arteries was preserved in four DA patients with SAH (two Vertebral, two Basilar DA), 1 incidental vertebral DA, and one DA patient with brainstem infarction using stents and coils (four patients) or coils only (two patient). Proximal occlusion of parent artery was performed in a vertebral DA with SAH. One patient with a superior cerebellar DA presented with a midbrain infarct developed SAH with spontaneous occlusion of the aneurysm two weeks later. Of the 14 cases, ten were angiographically stable or cured during a follow up period of four to 70 months. one spontaneously resolved and two recurred. There was one death.

Introduction & Aim

The main aim of this study is to determine the optimal management with particular reference to endovascular techniques and medical treatment, in terms of safety and efficacy, for posterior fossa arterial dissections (AD) and dissecting aneurysms (DA) by combining our own experience with published data. In particular, safety is measured by complication rates and efficacy is measured by the durability and long term result of each management strategy.

Material and Methods

Review of our institutional interventional neuroradiology database from July 1998 to November 2007, a period of nine years and four months generated 14 definite cases of dissecting aneurysms. The diagnosis was based on the angiographic morphology. The male: female ratio is 6:8. The age ranged from 21 to 67 years with mean of 47.7 years. 11 presented with SAH, 1 with non haemorrhagic infarct preceded seven months earlier with SAH, 1 with infarct only and one incidental.

The inclusion criteria for our patients for this study are:

1) Clinical: Incidental finding, SAH and ischaemia/non haemorrhagic infarct (which are clinically in the territory of the dissection).

2) Aneurysms: a) Double Lumen sign (false lumen or intimal flap), b) stenosis with dilatation (pearl and string), c) Dilatation without stenosis, d) Stenosis without dilatation (string sign), e) Tapered occlusion.

3) Management strategy: Endovascular or medical management.

Medical treatment included treatment with anticoagulation and/or antiplatelets medications. Our patients were treated as soon as possible, varying from 2 to 26 days after the onset of SAH.

Where interventional procedures were performed, the end points are: 1) technical complications, 2) new episodes of SAH or ischaemia/non haemorrhagic infarct in the immediate post treatment period before discharge and during follow-up, 3) whether the treated dissec-

tion remained angiographically stable, improved or cured (complete occlusion) or angiographically worsened (enlargement or recurrence of the aneurysm)

Where medical treatment was instituted, these are 1) new episodes of SAH or ischaemia/non haemorrhagic infarct in the immediate post treatment period before discharge and during follow-up; 2) whether dissection remained angiographically stable, improved or cured (complete occlusion) or angiographically worsened (enlargement of the aneurysm).

Endovascular techniques and material

For our patients, all endovascular interventional procedures were performed under general anaesthetic. Patients for intracranial stenting are premedicated with antiplatelet agents, usually clopidogrel. Clopidogrel was either administered as a stat dose of 300 mg the night before the procedure or in emergency cases; 600 mg was administered via a nasogastric tube during the procedure or at completion. All elective and some acute patients were heparinised to an activated clotting time (ACT) of twice normal during the procedure. Most of the coils used were GDC 10 Soft or Ultrasoft (Boston Scientific, Target). A small number of Micrus Ultipaq (Micrus Endovascular) and Hydrocoils (Microvention, Terumo) were also used. Only Neuroform 2 and 3 self expanding stents (Boston Scientific, Target) were used. The glue was Histoacryl (Braun) diluted with Lipiodol Ultra Fluid (Guerbet) giving a 75% concentration of glue. Occlusion balloons were Goldbal (Balt, France). Grading of SAH was based on the World Federation of Neurosurgeons (WFNS) scale. Clinical outcome where indicated was based on the Glasgow Outcome Score (GOS).

Results

The results are displayed in Table 1.

For six patients (3 Vertebral DA [patients 4,7,8], one posterior cerebral (PCA) DA [patient 11], one posterior inferior cerebellar (PICA) DA [patient 12], and 1 anterior inferior cerebellar (AICA) DA [patient 13]) presenting with SAH, the dissecting aneurysms and the immediate adjacent segments of the parent arteries were completely occluded (internal trapping of aneurysm - ITA). In four patients (patients 4,7,8,12) only coils were deployed and remained angiographically cured up to 70 months (17 to 70 months). The patient with the PCA dissection (patient 11), had glue embolization into the sac of the aneurysm as well coil occlusion of the adjacent parent artery to completely occlude the inflow, and the distal AICA dissection (patient 13) was treated with glue embolization only with angiographic cure at 7 and 12 months respectively.

For four SAH patients (2 VDA [patients 2,5], 2 Basilar DA [patients 9,10]) and another patient with incidental VDA (patient 6), the patency of the parent arteries were preserved by treating the DA using stents and coils in four patients (patients 2, 5, 6, 9) and coils only in a patient with an eccentric basilar trunk DA (patient 10). Four aneurysms (patients 2,5,6,10) were 80 – 90% occluded with only 1 VDA worsening at nine months which was retreated with proximal occlusion of parent artery (POPA). The remaining three patients were stable up to 24 months. The fifth patient (patient 9) with a large fusiform basilar DA treated with stenting/coiling died 1 day after the procedure.

For one SAH patient with vertebral DA (patient 3), POPA using coils and balloons was performed with near complete occlusion of the aneurysm at 6 month.

There was ongoing recurrent dissection of a vertebral-basilar junction DA despite complete occlusion with coils on two separate occasions (patient 1) and a spontaneous occlusion of a superior cerebellar DA within two weeks of presentation (patient 14).

Patients 2 (Figure 1) and 5 (Figure 2) are used as illustrative cases.

Complications

In our series, there were three definite procedural related complications (patients 12,13,9) leading to infarction in two and death in the other patient. During internal trapping of a PICA DA, the aneurysm was perforated (patient 12). Further coiling completed the occlusion but despite collateral reforming the PICA, a PICA hemispheric infarct occurred. The patient was moderately disabled at 17 months (GOS 3) but the aneurysm remained occluded.

Patient 13 had an AICA DA. The dissected portion and the false aneurysm were embolized with glue. The AICA had annexed some distal PICA territory resulting in a small PICA infarct.

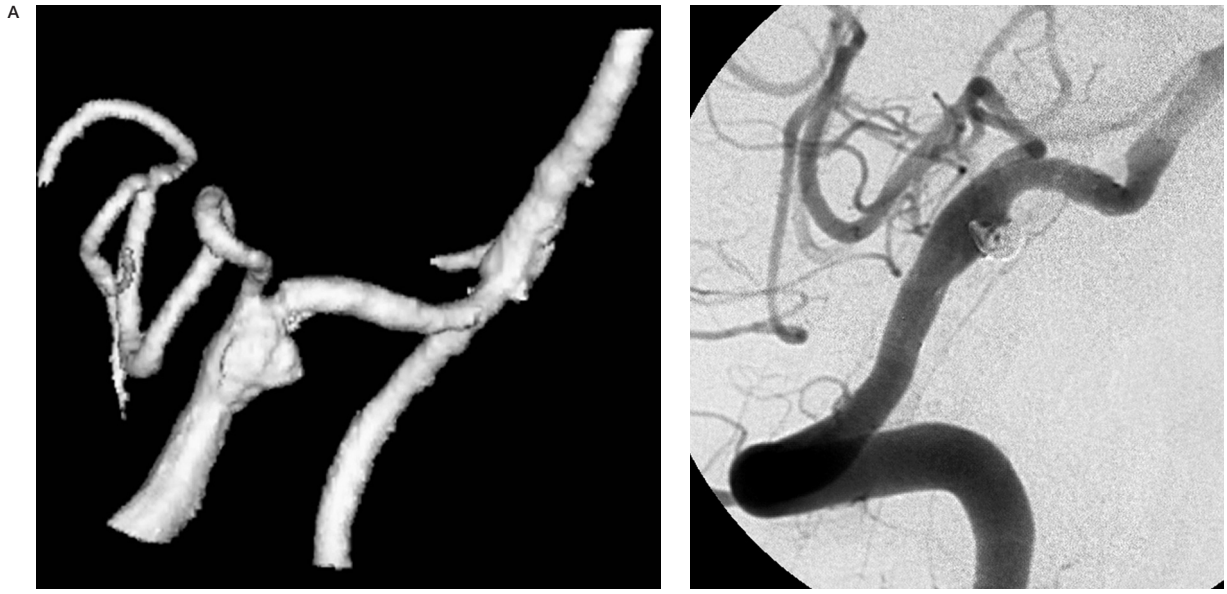

Figure 1 (Patient 2). A) Right VDA involving PICA is demonstrated. 2 Neuroform 2 stents (4x15 mm and 4x20 mm) were deployed within each other followed by insertion of 2 GDC coils. B) The coil mass is confined to the false aneurysm sac by the 2 stents preserving the vertebral artery and the PICA and remained stable at 24 months follow-up angiogram.

Patient 9 presented with grade 1 SAH from a large DA involving the distal basilar trunk extending to the PCA bilaterally. Initial treatment was the deployment of 8 GDC coils into the eccentric portion of the aneurysm sac which enlarged four months later resulting in brain stem compression.

After premedication with clopidogrel, he was treated the next day. Two Neuroform 2 stents overlapping each other were deployed from the right PCA to the basilar trunk. The patient was fully heparinised. At total of 14 coils were deployed. At completion, all terminal branches of the basilar were patent. A CT scan was performed at the end of the procedure and showed subarachnoid blood in the posterior fossa. There were no physiological or angiographic evidence of perforation during the procedure and it was thought that this was due to wire perforation of a small branch during stent delivery. The following day, the patient suffered further haemorrhage and brainstem infarction and died.

There was a small loop of coil in parent artery (patient 6) with no clinical sequelae related to the event.

For all the other cases (2,3,4,8,11) it is difficult to know whether the infarctions were related to the effect of the initial dissection, the vasospasm or the procedure itself.

Discussion

Medical Management of non SAH – Vertebral Artery Dissection (VAD) and Basilar Artery Dissection (BAD)

Spontaneous resolution of AD have been documented radiologically [1,2,3,4,5,8]. In Kitanaka [1] series of 6 patients with brain stem ischemia and managed conservatively, only 1 developed a further brainstem infarction, with 4 angiographic cure over a period of 2.5 years. Although anticoagulation or antiplatelet agents have been used successfully in treating AD [3,4,8], AD presenting initially as infarct can subsequently develop SAH [7, our series].

Subsequent SAH was associated with significant hypertension and anticoagulation [1].

Pozzati [8] reported a series of ten patients with basilar dissection, six presenting with SAH and four with ischaemia. One SAH patient rebled at day 9 and died. Hence, nine were followed-up (mean 7.2 years) without rebleed or further neurological deficit from the dissection. All except 1 patient with SAH were treated medically. Yoshimoto [6] treated 5 patients with BAD and brainstem ischaemia conservatively. No SAH developed in patients presenting with ischaemia during a two year follow up period.

Literature review found 28 patients [1,3,6,8,our series] with VAD and BAD presenting with ischae-

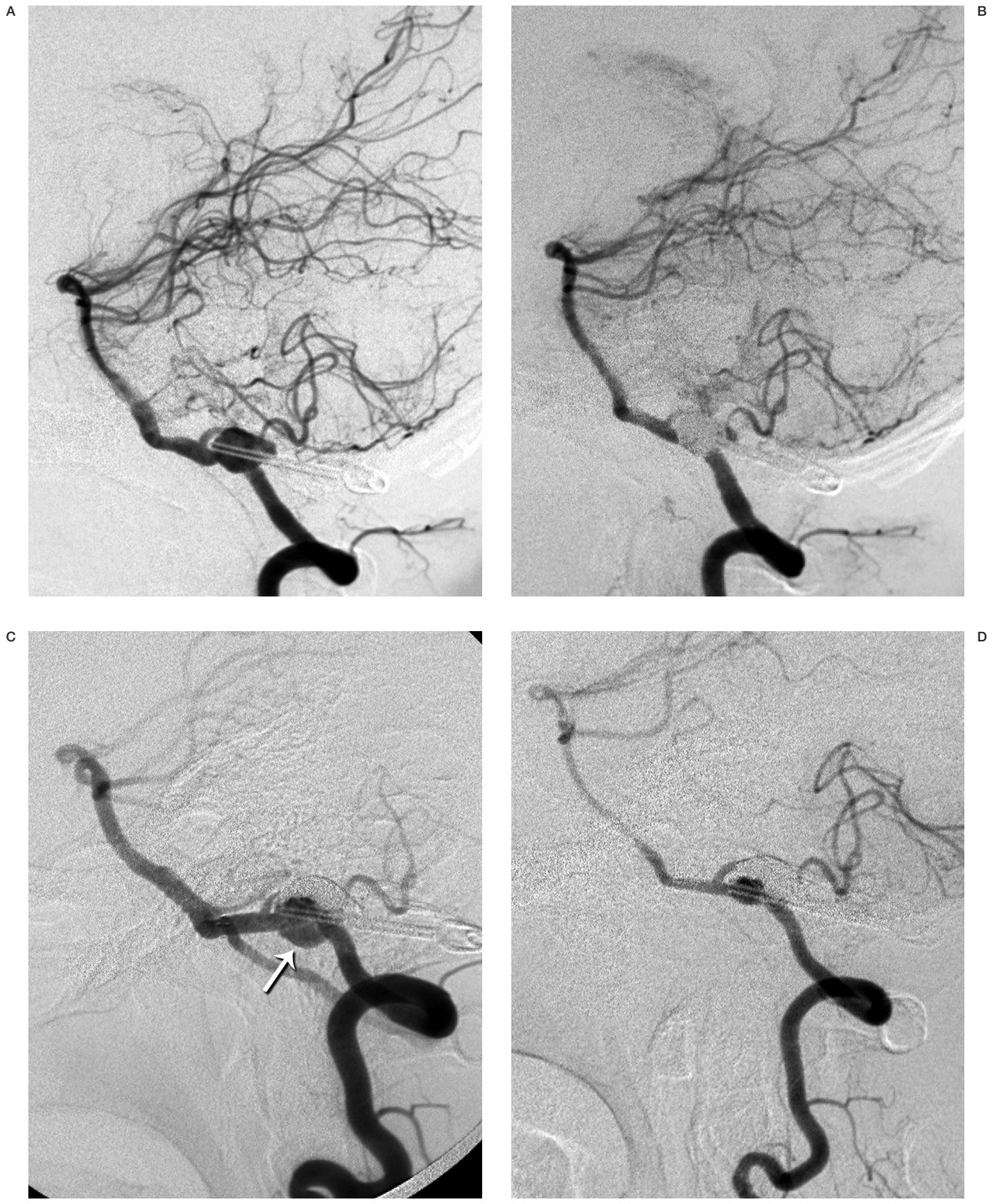

Figure 2 (Patient 5). A) Residual aneurysm sac after partial clipping of a right vertebral DA. B) A 4x20 mm Neuroform three stent was inserted across the neck and overlapped the PICA origin. A total of 20 coils were deployed resulting in nearly complete occlusion of the sac. C) nine months later, a recurrent DA (arrow) has developed opposite to the now occluded initial sac. After tolerating 30 minutes of BTO, two Goldbal2 balloons were detached at C2. D) Despite reopening of the right vertebral due to balloon deflation, the DA was significantly occluded seven months after POPA and 19 months after first treatment.

mia/infarct who were managed conservatively and who had follow-up to 24 months. Analysis revealed only development of 3 SAH (10.7 % [95% CI: 0.0% – 22.1%]) and 1 further infarct (3.5 % [95% CI: 0.0% - 10.3%]). 23 patients had follow-up angiograms (18.9 weeks to 5 years) and only two patients had worsening of the angiographic appearance (8.6% [95% CI: 0.0% - 20.16%]). The remainder 21 patients were stable, improved or cured (91.3% [95% CI: 79.8 – 100%]).

There has been little literature on stenting of intracranial AD/DA presenting with ischaemia/infarction.

However, recent studies of the Wingspan self expanding stent (Boston Scientific), showed promise in the treatment of intracranial atherosclerotic stenosis. Nevertheless, it is not without complication, with reported combined periprocedural major neurological complication and death rate of 6.1% and a restenosis rate of 18.2 to 20% [9,10]. Given that stenting does not completely prevent subsequent SAH, and the relatively high rate of spontaneous resolution of these AD/DAs, stenting in these circumstances should be used cautiously.

The suggested management of posterior fossa arterial dissections presenting with ischaemia/infarct is treatment with antiplatelet drugs. Hypertension should be well controlled. Anticoagulation should be used cautiously. Endovascular treatment (including stenting) should be considered if there is a hemodynamically significant stenosis and/or progression of symptoms and if the follow-up angiogram shows persistent double lumen or retention of contrast or subsequent development of a false aneurysm.

Management of Vertebral Dissecting Aneurysms (VDA) resulting in SAH

Including our series, 31 cases of VDA, with and without PICA involvement, treated by POPA were reviewed [2,11, our series]. There was 1 peri procedural infarction (3.2% [95% CI: 0.0% - 9.4%]) and no procedure related haemorrhage. Clinical follow-up for 15 patients with a mean follow-up of 24 months (range 6 to 42 months) showed 1 new infarct (6.7% [95% CI: 0.0% - 19.3%]) which occurred at 24 hours and 2 new cases of subarachnoid haemorrhage (13.3% [95% CI: 0.0% - 30.5%]) within two weeks. 13 patients have angiographic follow-up to 12 months with no aneurysm recurrence or enlargement.

Fifty-seven cases of internal trapping for VDA were collected [2,11,12,13,14, our series]. There were 5 cases of peri procedural infarction (8.4 % [95% CI: 1.2% - 15.6%]). Of these five cases, only 2 (3.5 % [95% CI: 0% - 8.3%]) were definitely related to the procedure. There was no related haemorrhage. Clinical follow up (mean 27.2 months) detected no new haemorrhages or infarct. Angiographic follow-up of 40 patients revealed three (7.6 % [95% CI: 0% - 15.6%]) cases of angiographic worsening of the VDA. Two of these worsening occurred within 24 hours and one at one year [2].

Including our series, 15 cases of combined stenting/coiling were performed [16,17,25, our series]. 4 VDA (1 patient had bilateral VDA) were treated with stents only, with 1 VDA treated with 2 overlapping stents [15,16,17]. There were no periprocedural infarcts but 1 rupture due to stent displacement 5.6% [95% CI: 0% - 16.6%]). There were no new infracts or haemorrhage in the mean follow-up period of 13.3 months. Angiographic follow-up of all 18 patients (mean of 8.8 months) demonstrated one aneurysm recurrence (5.6% [95% CI: 0% - 16.6%) despite combined stenting and coiling. In two cases, the PICAs remained patent up to two years despite crossing the origin of the PICAs with two stents [16, our series]. Of the three VDA who were treated with a single stent, one patient had persistence of the aneurysm which underwent complete occlusion after a second stent [16] suggesting that treatment of DA with a single porous stent only is not reliable. There was no report of significant neointima stenosis.

Problems with balloon expandable stents including inadequate length and diameter, under expansion, flexibility, trackability and radiopacity can be overcome by the newer self expandable nitinol stents. Stenting necessitate the need for antiplatelet agents which can be problematic as contralateral dissection can occur subsequently [2,14].

For VDA, these data indicate that ITA and stenting/coiling are more protective for rebleeding compared to POPA even though there is higher procedural related ischemia and haemorrhage. It is safe to overlap PICA origin with stents. However, neither ITA nor stenting/coiling can always prevent recurrence of dissection.

Table 1 **Management Strategy and Results.**

Pat, Age, Sex	Present-ation	Site	Manage-ment Strategy	Immediate Result of Treatment			Immediate Post Treatment Period		Follow-Up			
				% Aneurysm occlusion	PA occlusion	Technical Compl'n	Infarcts/ territory	Asst'd V'spasm	Period	New Infarcts	New SAH	Angio Stability
(1) 39, m	Infarct	L Vert-Basilar jn	Coils	100%	No	No	No	No	12 mo	Yes	No	Recurrence
		Reccurent An	Coils	100%	No	No	No	No	14 mo	Yes	No	Cured
(2) 38, f	SAH	R Vert involving PICA origin	coils & stents X 2	80%	No	No	Yes/ Bilateral cerebellar	Yes	24 mo	No	No	Stable
(3) 66, f	SAH	R Vert involving PICA origin	coils & balloon (Prior BTO)	No occlusion	Yes, adjacent to An & at C2	Coil migration	Yes/R cerebellar	Yes	6 mo	No	No	Improved (An 95% occluded)
(4) 64, f	SAH	L Vert	coils	100%	Yes, adjacent to An	No	Yes/L cerebellar	Yes	24 mo	No	No	Cured
(5) 28, m	SAH	R Vert, Large eccentric aneurysm partially clipped	Stage 1 coils & stents X 1	90%	No	No	No	No	9 mo	No	No	Recurrence
		Recurrent An	Stage 2 Balloons X 2 (Prior BTO)	No occlusion	Yes, Proximal at C2	None	No	No	19 mo	No	No	Improved (An 90% occluded)
(6) 58, f	Inciden-tal	R Vert involving PICA origin	Coils & stent X 1	80%	No	Coil in PA	No	No	4 mo	No	No	Stable
(7) 63, f	SAH	R Vert	coils	100%	Yes, adjacent to An	No	No	No	70 mo	No	No	Cured

Pat, Age, Sex	Present-ation	Site	Manage-ment Strategy	Immediate Result of Treatment			Immediate Post Treatment Period		Follow-Up			
				% Aneurysm occlusion	PA occlusion	Technical Compl'n	Infarcts/ territory	Asst'd V'spasm	Period	New Infarcts	New SAH	Angio Stability
(8) 53, m	SAH	R Vert	coils	100%	Yes, adjacent to An	No	Yes/ R PICA	Yes	36 mo	No	No	Cured
(9) 21, m	SAH	Distal basilar trunk	coils & stents X 2	Partial occlusion	No	Guidewire perforation of distal vessel	Yes/ Brainstem (Death)	No				
(10) 54, f	SAH	Basilar trunk	coils	80%	No	No	No	No	4 mo	No	No	Stable
(11) 26, f	SAH	L PCA	Coils & glue into An sac	100%	Yes, adjacent to An with coils	No	Yes/ L MCA L PCA Bil ACA	Yes	7 mo	No	No	Cured
(12) 65, m	SAH	L PICA	coils	100%	Yes, but PICA reformed by collaterals	Perforation	Yes/ R PICA	Yes	17 mo	No	No	Cured
(13) 67, f	SAH	R AICA	glue	100%	Yes, adjacent to Aneurysm	Yes/ Glue in hemisphere branch	Yes/R PICA	No	12 mo	No	No	Cured
(14) 27, m	Infarct Mid-brain	R SCA	Aspirin						2 weeks 10 mo	No No	SAH No	Spont cure Cured

Legend: An, aneurysm; V'spasm, Vasospasm; PA, Parent Artery; Pat, Patient; R, right; % Aneurysm occluded, denotes whether the aneurysm is occluded and the degree of occlusion; L, Left; PA occlusion, Denotes whether the parent artery is occluded or not; Mo, months; Compl'n, complications; Asst'd, Associated; Vert, Vertebral; PICA, Posterior inferior cerebellar artery; BTO, balloon occlusion test; PCA, Posterior cerebral artery; infarcts/territory, Infarcts and territory of the infarcts; AICA, Anterior inferior cerebellar artery; Bil, bilateral; SCA, Superior cerebellar artery; m, male; MCA, Middle cerebral artery; f, female; ACA, Anterior cerebral anterior; jn, Junction; C2, Cervical vertebral level; Angio Stability, Angiographic stability (stable, improved, cured [complete occlusion] or worsened [enlargement or recurrence of the aneurysm]]; Spont cure, spontaneous occlusion of aneurysm.

Management strategies for VDA resulting in SAH

For VDA without PICA involvement, ITA is the treatment of choice if the contralateral vertebral is not hypoplastic. If this is not possible, then POPA is an alternative. However, it is possible that stenting/coiling could replace ITA. If the contralateral vertebral is hypoplastic, then stenting and coiling to preserve the vertebral artery is indicated. If none of the above is applicable, it is possible to proximally occlude the dominant vertebral artery when there is good collateral flow from the posterior communicating artery after successful balloon test occlusion (BTO).

For VDA with PICA involvement, stenting and coiling is indicated. If stenting/coiling is not possible, and the contralateral vertebral is not hypoplastic, POPA is an alternative. Other options include internal trapping after successful BTO. If BTO is not tolerated and there are insufficient collaterals, then ITA with surgical revascularisation of the PICA should be considered. A large posterior communicating artery can provide adequate collaterals for POPA if the contralateral vertebral is hypoplastic [2,12].

For Bilateral VAD, bilateral stenting and coiling should be considered first. If this is not possible, then conservative medical management is an alternative for this difficult situation of bilateral VAD.

Management of Basilar Artery Dissection – BAD with SAH

Basilar artery dissection (BAD) often presents with ischaemia, brain stem compression and less often with SAH [6,8]. It appears that are 2 groups of patients with BAD which have a more benign course [8]. These include grade I or II SAH patients and those with chronic BAD with slow evolution characterised with small strokes, TIA, and SAH. However, in the acute phase, the imaging appearance cannot predict the subsequent course. In this review [6,8,16,18, our series], eight patients were treated medically with one rebleed. Two patients had proximal vertebral occlusion with one rebleed. Five patients had stenting/coiling with one peri-procedural infarct, one haemorrhage and one death.

Redekop [19] presented a patient with bilateral VAD and BAD treated successfully with staged bilateral vertebral occlusions with subsequent thrombosis of the aneurysms. The size of the posterior communicating arteries was good predictor of tolerance of basilar occlusion ($p < 0.05$) [20]. More recently, evidence that stenting and coiling for managing posterior fossa DA could be beneficial is demonstrated by recent presentations at international conferences which included 33 cases of VDA and BDA treated with stenting and coiling with good outcome [21].

Managing strategies for BAD resulting in SAH

Management will need to be tailored to each patient. In the acute phase stenting and coiling should be considered. If the anatomy is not suitable for stenting/coiling, unilateral or staged bilateral vertebral occlusions could be performed after successful BTO. In cases where the above are not possible or in chronic phase of the disease, conservative treatment with close follow-up imaging to treat progressive lesions or further SAH is a reasonable option.

Management Strategies of other Posterior Fossa Arterial Dissection

Management of PCA Artery Dissection

Lazinski [22] reported six cases of PCA dissection involving the P1/P2 and P2/P3 segments of which two patients with SAH and one patient with infarction were managed with ITA complicated by one infarction. Two of these aneurysms remained occluded up to seven months. The symptoms of the other three non SAH patients treated medically resolved. Sherman [22] reported on three ischemic cases managed with medical treatment with no new stroke or SAH in a follow-up period of up to 12 months. Occlusion of the proximal PCA at the P2 segment is often well tolerated due to rich anastomosis from the anterior choroidal and leptomeningeal collaterals.

The suggested management strategy for SAH and progressive ischaemic lesions is ITA. Stable ischaemic lesions, should be managed conservatively with antiplatelets.

Management of PICA Artery Dissection

Dinichert [24] reviewed 24 cases of PICA dissecting aneurysms including three of his own series. 14 had SAH and two combined ischaemia and SAH. Six patients had surgical clipping, trapping or resection of the aneurysms without surgical revascularisation of the PICAs complicated by one infarction. Four patients had the PICAs occluded endovascularly resulting in two cases of mild transient neurological

symptoms which resolved within two weeks. Hence, of the ten patients who had deconstructive treatment, only one had permanent deficit as a result of complications. ITA of our case of PICA DA resulted in rupture and infarction (patient 12). In this review of five patients treated with ITA[24, our series], there were no recurrent SAH or aneurysm up to 17 months. It would appear that occlusion at the level of the dissecting segment itself is well tolerated even where the dissected segment involve the anterior medullary segment where there are high rates of perforators. One reason is that the dissection has already occluded the perforators. Kitanaka suggested that sacrificing the PICA is not always dangerous due to the rich pial anastomosis [25] The suggested management strategy for SAH patients is ITA after successful BTO.

If there is insufficient collaterals, bypass surgery could be performed followed by surgical or endovascular trapping. Patients with ischaemia should be managed medically, including antiplatelets.

Distal dissection involving PICA, AICA, SCA or PCA can be treated with parent artery occlusion at the dissection site with glue and/or coils.

Conclusions

Posterior fossa dissections can occur in different territories, age groups and modes of presentation (SAH, infarction or mass effect). The pathological anatomy and natural history varies significantly and therefore management strategies will need to be individualised according to the site of dissection, configuration of the dissection, collateral circulation, whether the parent artery (PA) needs to be preserved and mode of presentation.

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